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FILE COPY



**THE UNIVERSITY OF TENNESSEE  
DEPARTMENT OF ELECTRICAL ENGINEERING**

**DEVELOPMENT  
OF A  
HIGH FREQUENCY  
STEERABLE ANTENNA**

Classified by 1041  
Executive Order 10451  
Date 10/10/1953

*Nina B. Weaver*

9/24/54

Department of State  
Agency

**Navy Department  
Bureau of Ships  
Electronics Divisions**

**Interim Development  
Report No. 13**

**Contract No. NObsr-57448  
Index No. NE-091035 ST7  
10 October 1953**

**A PROJECT OF THE ENGINEERING EXPERIMENT STATION  
THE UNIVERSITY OF TENNESSEE COLLEGE OF ENGINEERING**

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**Knoxville 16, Tennessee**

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INTERIM DEVELOPMENT REPORT  
FOR  
DEVELOPMENT OF A HIGH FREQUENCY  
STEERABLE ANTENNA

This report covers the period  
1 September 1953 to 30 September 1953

ENGINEERING EXPERIMENT STATION  
THE UNIVERSITY OF TENNESSEE  
KNOXVILLE, TENNESSEE

Navy Department

Electronics Divisions

Bureau of Ships

Contract No. NObsr-57448

Index No. NE-091035 ST7

10 October 1953

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# ABSTRACT

This report covers work done on Contract No. NObsr-57448 Index No. NE-091035 ST7, at The University of Tennessee during the month of September, 1953.

The following was accomplished:

1. The calculation of vertical patterns of the Maypole antenna was continued.
2. The construction of an experimental model of the circular traveling-wave antenna was started.
3. The theoretical work on vertically stacked rhombics was continued.

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## PART I

### Purpose

This project involves the development of a high frequency steerable antenna having the following characteristics:

1. It shall be operable throughout the frequency range of 4 to 32 megacycles per second.
2. It shall be capable of four, or more, simultaneous transmissions on different frequencies, and at different azimuth and elevation angles.
3. For each transmission, it shall be capable of being directed to any azimuth angle and to any elevation angle between the horizon and  $30^{\circ}$  above the horizon.

The communication system shall provide reliable 24-hour day-to-day communication with a 20 decibel signal-to-noise ratio. The ranges to be covered are from approximately 500 nautical miles to 4000 nautical miles.

The development consists of two phases:

Phase I. Theoretical and experimental studies.

Phase II. Development of design criteria.

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**General Factual Data**

**Personnel:**

F. V. Schultz	Project Director	72 1/2	Man-hours
W. O. Leffell*	Assistant Engineer	15	Man-hours
W. J. Bergman	Junior Engineer	112	Man-hours
H. P. Neff	Junior Engineer	176	Man-hours
L. W. Ricketts*	Junior Engineer	104	Man-hours
G. R. Turner	Secy-Draftsman	16	Man-hours
L. Phillips	Technician	44	Man-hours
W. H. Williams	Technician	4	Man-hours
N. Norris	Secretary	2	Man-hours
R. M. Johnson	Student Computer	10	Man-hours
H. W. Knox	Student Computer	124 1/2	Man-hours

\* Preparation of antenna test facility.



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### Detail Factual Data

1. The antenna pattern recorder was received late in the month and its installation was started.
2. The limited investigation of tilted V, or Maypole, antennas was continued. Calculations are being made of the vertical pattern through the plane of symmetry of the antenna to show the variation in this pattern when one of the following three antenna parameters is varied and the other two are held constant: leg length ( $L$ ), height ( $h$ ) and included angle ( $2\gamma$ ). These calculations have turned out to be more lengthy than at first estimated.
3. Work was started on the construction of models of the circular traveling-wave antenna to be used in determining experimental patterns of this antenna.
4. The investigation was continued of determining the possibilities of steering the antenna beam in the vertical plane by using two rhombics stacked vertically. This work has not progressed far enough to warrant the statement of any results.
5. The requested Signal Corps report on angles-of-arrival was not received so no work was done on this phase of the project.



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Conclusions:

None.

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## DEPARTMENT OF ELECTRICAL ENGINEERING ENGINEERING EXPERIMENT STATION THE UNIVERSITY OF TENNESSEE

### PROJECT PERFORMANCE AND SCHEDULE

Index No. NE-091035 ST7

Contract No. NObsr-57448

Date: 10 October 1953

Legend:  Work Performed

Period Covered: 1/9/53 to 30/9/53

Schedule of Projected  
Operation

Subject	1952				1953								V	V	
	S	O	N	D	J	F	M	A	M	J	J	A			S
1. Development of Field Test Facilities															
2. Study of Propagation Problem															
a. Investigation of paths lying entirely in night region.															
b. Investigation of paths lying entirely in day region.															
c. Investigation of paths lying partly in day and partly in night region.															
d. Investigation of auroral refraction.															
e. Investigation of angles-of-arrival.															
3. Determination of Suitable Antenna Type or Types.															
a. Search of literature.															
b. Theoretical study.															
4. Detailed Theoretical and Experimental Investigation of Most Promising Antenna Types.															
5. Development of Network System Suitable for Driving Array.															
6. Experimental Study of Final Array.															
7. Preparation of Phase Report.															

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## PART II

### Program for Next Interval

1. The antenna pattern recorder will be installed.
2. The calculations of antenna patterns of a Maypole antenna will be continued.
3. Experimental work will be continued on the circular traveling wave antenna. The first task will be that of correctly terminating the antenna in order to reduce the reflected wave as much as possible.
4. The investigation of the possibility of accomplishing vertical steering of the antenna beam by using two rhombics stacked vertically will be continued.
5. Work will be started to determine the characteristics of a vertical half-rhombic mounted over an earth of finite conductivity.

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